Does Anderson always Accelerate Picard ?

R. Haelterman [a], D. Van Eester [b], J. Degroote [c], S.-F. Cracana [d],

[a] *Royal Military Academy, Department of Mathematics, Renaissancelaan 30, B-1000 Brussels, Belgium. robby.haelterman@mil.be – +32/2/4414083*

[b] *Laboratorium voor Plasmafysica - Laboratoire de Physique des Plasmas, Association "EURATOM - Belgian State", Trilateral Euregio Cluster, Renaissancelaan 30, B-1000 Brussels, Belgium*

[c] *Department of Flow, Heat and Combustion Mechanics, Ghent University, Sint-Pietersnieuwstraat 41, B-9000 Ghent, Oost-Vlaanderen, Belgium*

[d] *Technical Military Academy of Bucharest, Bulevardul George Coşbuc 81-83, Bucureşti 050141, Romania*

Abstract

Complex partitioned solution methods have often been solved using the Picard fixed-point iteration because of its simplicity. More recently, Anderson Acceleration has been re-discovered as a sure means to accelerate the Picard iteration. Indeed, it has been proven that, whenever the Picard iteration converges, the Anderson acceleration technique will result in equal or faster convergence. However, as we will show, Anderson acceleration has not always been applied wisely to the Picard iteration, as the fine print of the aforementioned proof is more often than not overlooked.

We will show how Anderson can be applied to a convergent Picard iteration, resulting in far worse convergence and even in divergence. We will also explain the reasons for this surprising behavior and present a sure way to avoid it.

For this purpose we use a simple fabricated pathological example together with a more elaborate model describing the elementary physics of a plasma inside a Tokamak.

Preprint submitted to Elsevier *9 January 2016*